**WAMC Lab Template**

Math Concept(s):

Source / Text:

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**Attach the following documents:**

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

**Short Description (Be sure to include where in your instruction this lab takes place):**

**Lab Plan**

Lab Title: Fastener Measurement Lab

Prerequisite skills: Using a caliper, reading a conversion chart

Lab objective: Measure the thickness and length of a fastener as well as head type. Take decimal form from caliper and convert it to standard rivet form. Width measured in 32nds, length measured in 16ths. Example: 6-6 (6/32 width, 6/16 length). Measure countersunk head from the top, universal from under the head.

**Standards:** *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

G-GMD.1
G-MG.1
G-MG.3

Standards for Mathematical Practice:

- 4) Model with mathematics
- 5) Use appropriate tools strategically
- 6) Attend to precision

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- RST.9-10.1
- RST.9-10.3
- RST.9-10.4
- RST.9-10.7
- W9-10.4
- SL9-10.1
- SL9-10.4
- L9-10.6

K-12 Science Standards

- SGSS: 1.1.C
- SGSS: 2.2.A

- SGSS: 2.2.C
- SGSS: 3.3.B
- SGSS: 5.5.A
- SGSS: 5.5.D
- SGSS: 6.6.B

Technology

- ET: 1.2.1
- ET: 1.3.2
- ET: 2.2.1

Engineering

- HS-ETS 1-2

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

**LEARNING AND INNOVATION**

Creativity and Innovation
☐ Think Creatively
☐ Work Creatively with Others
☐ Implement Innovations

Critical Thinking and Problem Solving
☒ Reason Effectively
☐ Use Systems Thinking
☒ Make Judgments and Decisions
☒ Solve Problems

Communication and Collaboration
☒ Communicate Clearly
☒ Collaborate with Others

**INFORMATION, MEDIA & TECHNOLOGY SKILLS**

Information Literacy
☐ Access and Evaluate Information
☐ Use and manage Information

Media Literacy
☐ Analyze Media
☐ Create Media Products

Information, Communications and Technology (ICT Literacy)
☐ Apply Technology Effectively

**LIFE & CAREER SKILLS**

Flexibility and Adaptability
☒ Adapt to Change
☒ Be Flexible

Initiative and Self-Direction
☐ Manage Goals and Time
☐ Work Independently
☐ Be Self-Directed Learners

Social and Cross-Cultural
☒ Interact Effectively with Others
☒ Work Effectively in Diverse Teams

**Productivity and Accountability**
☐ Manage Projects
☐ Produce Results

Leadership and Responsibility
☐ Guide and Lead Others
☐ Be Responsible to Others

**Teacher Preparation: (What materials and set-up are required for this lab?)**

Materials

- Pencil
- Dial caliper
- Cup of random fasteners
- Fraction/Decimal Conversion Chart
- Lab Sheet

Set-Up Required:

- No special set-up

**Lab Organization Strategies:**

Leadership (Connect to 21st Century Skills selected):

- Students work in pairs and must communicate and collaborate effectively.

Cooperative Learning:

- Students work in pairs, discuss as a group as a wrap up activity.

Expectations:

I want students to be able to accurately size the length and diameter of a rivet (screw).

Timeline:

- 30 minutes

**Post Lab Follow-Up/Conclusions:**

Discuss real world application of learning from lab

- Gives students better understanding of relationship between decimal/fractions. Give students the ability to use another type of precision measurement device.

Career Applications

- Apply for an introductory position at an Aerospace Manufacturing facility such as Hexcel Corporation, Janicki Industries, AMT Senior Aerospace, Boeing and so on.

Optional or Extension Activities

-

Applied Math Summer 2019
Rivet (Screw) Measuring Lab

Name _____

Date _____

**Purpose:** Measure the diameter and length of screws (rivets) by using a dial caliper. Convert the decimal answers to standard rivet form (fractions).

**Skill:**

1. Using a dial caliper
2. Converting decimals to US standard fractions (such as 16ths and 32nds)
3. Using a decimal equivalents card

**Explanation:**

Rivet sizes are expressed as 2 separate numbers separated by a hyphen. The first number is always the rivet diameter and is always written in graduations of 32nds of an inch. Only the numerator is ever used. The denominator is assumed.

**Diameter Example:** .156 = 3/16 = 6/32 = **6**

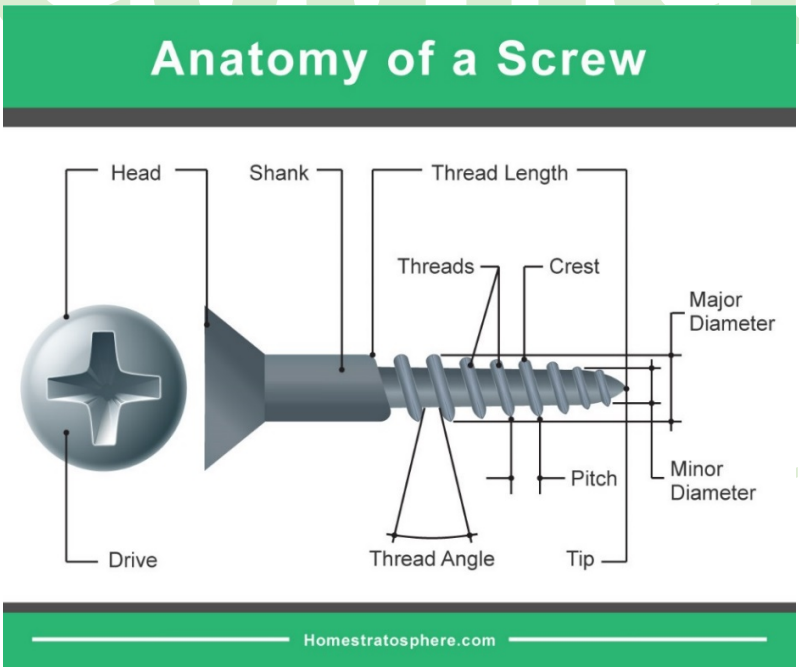
The second number is always the length and is always written in graduations of 16ths of an inch. The same rules apply from apply.

**Length Example:** .312 = 3/8 = 6/16 = **6**

The rivet from above would be called a:

**6-6**

In this particular lab, we will be utilizing screws rather than rivets because of availability. The skill is measuring diameter and length so don't worry about the fact that the rules pertain to rivets and we are using screws. **HOWEVER:** The screws you will be using today ARE NOT "highly precise". Just round to the nearest appropriate fraction.



Applied Math Summer 2019
Rivet (Screw) Measuring Lab

Name _____

Date _____

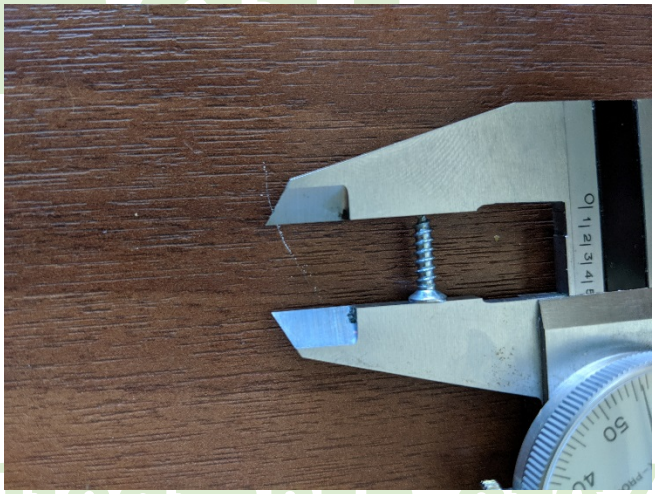
## Special Note:

There are 2 different head types:

- Protruding Head
- Flush Head

When measuring the length of a protruding head rivet (screw), measure from just under the head of the fastener to the end.


When measuring a flush head screw (rivet), measure the entire length of the fastener. Always measure from the middle of the jaws.



Record all data on the next page.

Applied Math Summer 2019
Rivet (Screw) Measuring Lab

Name _____

Date _____

Tape your rivet (screw) to your worksheet in the space given. Don't forget to list the length and width in appropriate graduations (16ths and 32nds). Tape your fastener to your lab sheet.



1. **tape screw here**_____
   a. Width _____
   b. Length _____

2. **tape screw here**_____
   a. Width _____
   b. Length _____

3. **tape screw here**_____
   a. Width _____
   b. Length _____

4. **tape screw here**_____
   a. Width _____
   b. Length _____

5. **tape screw here**_____
   a. Width _____
   b. Length _____

6. **tape screw here**_____
   a. Width _____
   b. Length _____

Applied Math Summer 2019
Rivet (Screw) Measuring Lab

Name _____

Date _____

You can decide how you want to grade it. Turn in or have table partner grade.

## Rubric

**4 – Exceeds expectation**

**3 – Meets expectation**

**2 – Approaching Standard**

**1 – Basic**

**Precision:**

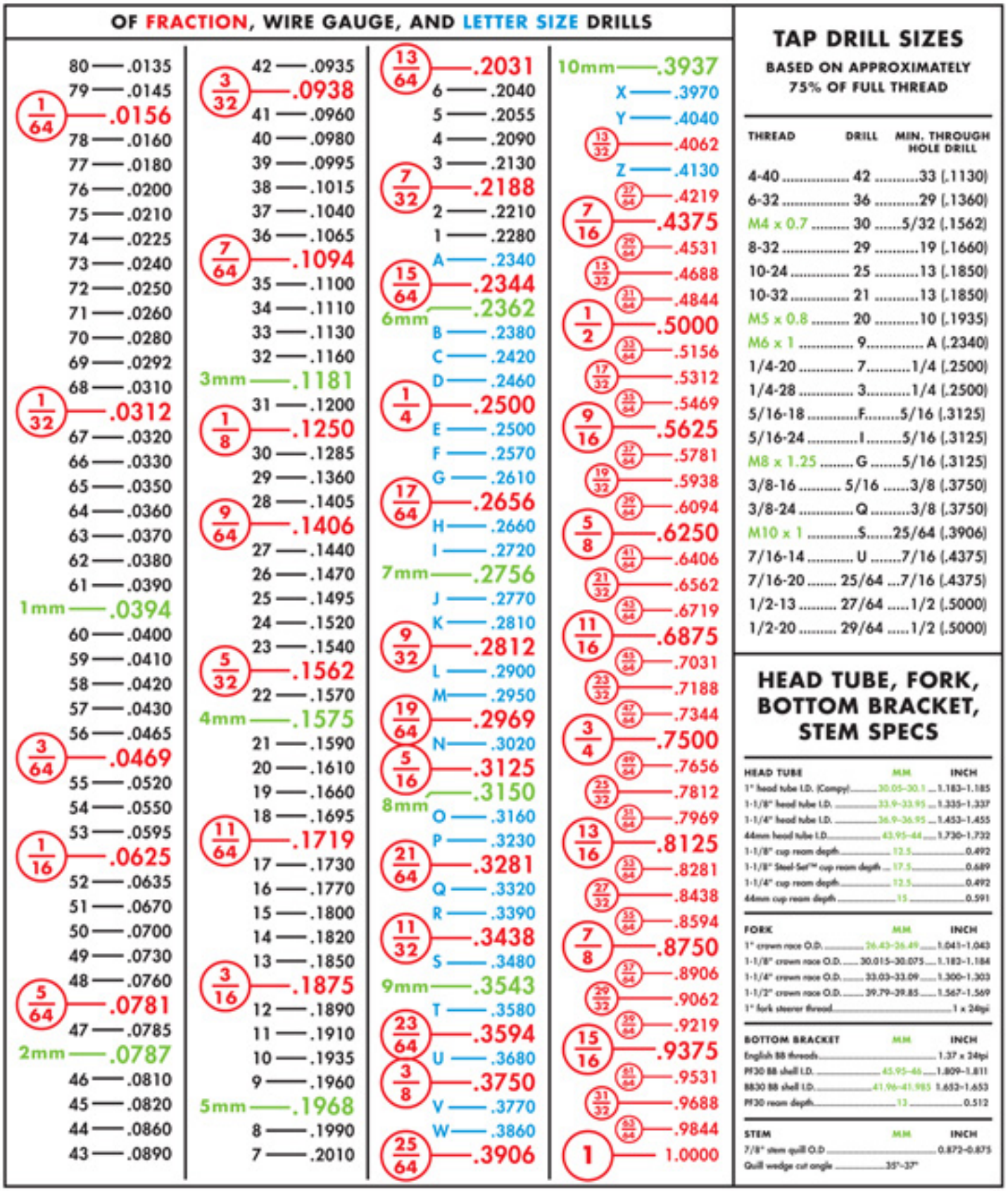
A. Screw diameters are measured accurately to within .030" _____
   - 4: all measurements are .030 or less
   - 3: majority of measurements are .030 or less
   - 2: majority of measurements are .030 - .120
   - 1: all measurements are > .120

B. Screws lengths are measured accurately to within .030". _____
   - 4: all measurements are .030 or less
   - 3: majority of measurements are .030 or less
   - 2: majority of measurements are .030 - .120
   - 1: all measurements are > .120

**Procedure:**

C. Instructions are followed precisely _____
   - 4: No procedural mistakes
   - 3: 1-2 procedural mistakes
   - 2: 3-5 procedural mistakes
   - 1: 6 or more mistakes

**Aerospace Manufacturing** **Decimal Equivalents and Tap Drill Sizes**



## OF FRACTION, WIRE GAUGE, AND LETTER SIZE DRILLS

| | | | |
|---|---|---|---|
| 80 — .0135 | 42 — .0935 | 13/64 — .2031 | 10mm — .3937 |
| 79 — .0145 | 3/32 — .0938 | 6 — .2040 | X — .3970 |
| 1/64 — .0156 | 41 — .0960 | 5 — .2055 | Y — .4040 |
| 78 — .0160 | 40 — .0980 | 4 — .2090 | 13/32 — .4062 |
| 77 — .0180 | 39 — .0995 | 3 — .2130 | Z — .4130 |
| 76 — .0200 | 38 — .1015 | 7/32 — .2188 | 27/64 — .4219 |
| 75 — .0210 | 37 — .1040 | 2 — .2210 | 7/16 — .4375 |
| 74 — .0225 | 36 — .1065 | 1 — .2280 | 29/64 — .4531 |
| 73 — .0240 | 7/64 — .1094 | A — .2340 | 15/32 — .4688 |
| 72 — .0250 | 35 — .1100 | 15/64 — .2344 | 31/64 — .4844 |
| 71 — .0260 | 34 — .1110 | 6mm — .2362 | 1/2 — .5000 |
| 70 — .0280 | 33 — .1130 | B — .2380 | 33/64 — .5156 |
| 69 — .0292 | 32 — .1160 | C — .2420 | 17/32 — .5312 |
| 68 — .0310 | 3mm — .1181 | D — .2460 | 35/64 — .5469 |
| 1/32 — .0312 | 31 — .1200 | 1/4 — .2500 | 9/16 — .5625 |
| 67 — .0320 | 1/8 — .1250 | E — .2500 | 37/64 — .5781 |
| 66 — .0330 | 30 — .1285 | F — .2570 | 19/32 — .5938 |
| 65 — .0350 | 29 — .1360 | G — .2610 | 39/64 — .6094 |
| 64 — .0360 | 28 — .1405 | 17/64 — .2656 | 5/8 — .6250 |
| 63 — .0370 | 9/64 — .1406 | H — .2660 | 41/64 — .6406 |
| 62 — .0380 | 27 — .1440 | I — .2720 | 21/32 — .6562 |
| 61 — .0390 | 26 — .1470 | 7mm — .2756 | 43/64 — .6719 |
| 1mm — .0394 | 25 — .1495 | J — .2770 | 11/16 — .6875 |
| 60 — .0400 | 24 — .1520 | K — .2810 | 45/64 — .7031 |
| 59 — .0410 | 23 — .1540 | 9/32 — .2812 | 23/32 — .7188 |
| 58 — .0420 | 5/32 — .1562 | L — .2900 | 47/64 — .7344 |
| 57 — .0430 | 22 — .1570 | M — .2950 | 3/4 — .7500 |
| 56 — .0465 | 4mm — .1575 | 19/64 — .2969 | 49/64 — .7656 |
| 3/64 — .0469 | 21 — .1590 | N — .3020 | 25/32 — .7812 |
| 55 — .0520 | 20 — .1610 | 5/16 — .3125 | 51/64 — .7969 |
| 54 — .0550 | 19 — .1660 | 8mm — .3150 | 13/16 — .8125 |
| 53 — .0595 | 18 — .1695 | O — .3160 | 53/64 — .8281 |
| 1/16 — .0625 | 11/64 — .1719 | P — .3230 | 27/32 — .8438 |
| 52 — .0635 | 17 — .1730 | 21/64 — .3281 | 55/64 — .8594 |
| 51 — .0670 | 16 — .1770 | Q — .3320 | 7/8 — .8750 |
| 50 — .0700 | 15 — .1800 | R — .3390 | 57/64 — .8906 |
| 49 — .0730 | 14 — .1820 | 11/32 — .3438 | 29/32 — .9062 |
| 48 — .0760 | 13 — .1850 | S — .3480 | 59/64 — .9219 |
| 5/64 — .0781 | 3/16 — .1875 | 9mm — .3543 | 15/16 — .9375 |
| 47 — .0785 | 12 — .1890 | T — .3580 | 61/64 — .9531 |
| 2mm — .0787 | 11 — .1910 | 23/64 — .3594 | 31/32 — .9688 |
| 46 — .0810 | 10 — .1935 | U — .3680 | 63/64 — .9844 |
| 45 — .0820 | 9 — .1960 | 3/8 — .3750 | 1 — 1.0000 |
| 44 — .0860 | 5mm — .1968 | V — .3770 | |
| 43 — .0890 | 8 — .1990 | W — .3860 | |
| | 7 — .2010 | 25/64 — .3906 | |

## TAP DRILL SIZES

BASED ON APPROXIMATELY 75% OF FULL THREAD

| THREAD | DRILL | MIN. THROUGH HOLE DRILL |
|---|---|---|
| 4-40 | 42 | 33 (.1130) |
| 6-32 | 36 | 29 (.1360) |
| M4 x 0.7 | 30 | 5/32 (.1562) |
| 8-32 | 29 | 19 (.1660) |
| 10-24 | 25 | 13 (.1850) |
| 10-32 | 21 | 13 (.1850) |
| M5 x 0.8 | 20 | 10 (.1935) |
| M6 x 1 | 9 | A (.2340) |
| 1/4-20 | 7 | 1/4 (.2500) |
| 1/4-28 | 3 | 1/4 (.2500) |
| 5/16-18 | F | 5/16 (.3125) |
| 5/16-24 | I | 5/16 (.3125) |
| M8 x 1.25 | G | 5/16 (.3125) |
| 3/8-16 | 5/16 | 3/8 (.3750) |
| 3/8-24 | Q | 3/8 (.3750) |
| M10 x 1 | S | 25/64 (.3906) |
| 7/16-14 | U | 7/16 (.4375) |
| 7/16-20 | 25/64 | 7/16 (.4375) |
| 1/2-13 | 27/64 | 1/2 (.5000) |
| 1/2-20 | 29/64 | 1/2 (.5000) |

## HEAD TUBE, FORK, BOTTOM BRACKET, STEM SPECS

| HEAD TUBE | M.M. | INCH |
|---|---|---|
| 1" head tube I.D. (Campy) | 30.05–30.1 | 1.183–1.185 |
| 1-1/8" head tube I.D. | 33.9–33.95 | 1.335–1.337 |
| 1-1/4" head tube I.D. | 36.9–36.95 | 1.453–1.455 |
| 44mm head tube I.D. | 43.95–44 | 1.730–1.732 |
| 1-1/8" cup ream depth | 12.5 | 0.492 |
| 1-1/8" Steel-Set™ cup ream depth | 17.5 | 0.689 |
| 1-1/4" cup ream depth | 12.5 | 0.492 |
| 44mm cup ream depth | 15 | 0.591 |

| FORK | M.M. | INCH |
|---|---|---|
| 1" crown race O.D. | 26.43–26.49 | 1.041–1.043 |
| 1-1/8" crown race O.D. | 30.015–30.075 | 1.182–1.184 |
| 1-1/4" crown race O.D. | 33.03–33.09 | 1.300–1.303 |
| 1-1/2" crown race O.D. | 39.79–39.85 | 1.567–1.569 |
| 1" fork steerer thread | | 1 x 24tpi |

| BOTTOM BRACKET | M.M. | INCH |
|---|---|---|
| English BB threads | | 1.37 x 24tpi |
| PF30 BB shell I.D. | 45.95–46 | 1.809–1.811 |
| BB30 BB shell I.D. | 41.96–41.985 | 1.653–1.653 |
| PF30 ream depth | 13 | 0.512 |

| STEM | M.M. | INCH |
|---|---|---|
| 7/8" stem quill O.D. | | 0.872–0.875 |
| Quill wedge cut angle | 35°–37° | |